NEW BRUNSWICK BLACK BEAR PROJECT

1989 - 90

- Progress Report - Year 1

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Summary

After several years of high black bear (Ursus americanus) harvests and increasing numbers of hunters purchasing bear licences, concern was expressed that bear populations may be being over-exploited in some areas of New Brunswick. In the spring of 1989, the Fish and Wildlife Branch of the Department of Natural Resources and Energy initiated a proposal for a two year project to develop a strategic plan for black bear management. This plan would incorporate objective measures of hunter effort and distribution, as well as a population model driven by black bear reproductive data collected within New Brunswick. Funding for the first year of this project was secured from a Federal - Provincial Planning Sub-Agreement and fieldwork commenced in May 1989.

The black bear population model proposed in this report is driven by factors affecting female reproduction. Examination of reproductive tracts collected from 51 female black bears gave mean placental scar counts of 1.66 for animals 3.5 to 4.5 years of age and 2.22 for bears 5.5 years or older. No placental scars were found in females less than 3.5 years old.

The 1989 bear hunter survey provided data on hunter effort and distribution. Bear hunters spent an average of 5.7 hours per day (primarily in the late afternoon) hunting bears. Wildlife Management Zones 15, 16, and 20, representing portions of Carleton, Charlotte and York counties, had the highest density of hunters. Hunters in Wildlife Management Zones 7 and 12, representing parts of Northumberland and York counties, expended the least effort to be successful than hunters in other zones.

The 1989 bear hunter survey revealed expenditures by resident and non-resident hunters. Each non-resident bear hunter spent an average of $754 in New Brunswick during the spring hunt. Residents spent an average of $192 per hunter. As a group, bear hunters had total expenditures of approximately $1.5 million during

the 1989 spring season.

Black bear population management requires managers to be able to objectively assess all factors influencing the dynamics of the populations under consideration. When there are several interacting factors, the best approach is to utilize or develop a population model. The Paloheimo and Fraser (1981) method of estimating harvest rate based on past harvest age and sex structure, can provide the preliminary estimate of population size that is the basis of the model. This method requires an estimate of hunter effort, available from the hunter survey, and total harvest data for the area under consideration, available from registration data.

Abundance of mast (food) crops (hard and soft) have been shown to directly affect the reproductive capability of females prior to hibernation. A method of assessing several mast species to provide an objective index of habitat quality is presented.

While the purpose of a population model is to be representative of a population and predictive, it is actual field assessment that determines if the predictions reflect reality. A method of indexing population trends using scent station methodology is proposed. This would allow managers to monitor population response to harvest strategies and other management actions.

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K.N.C.

Introduction

Concern for the sustainability of New Brunswick's black bear populations and the need for better information for management are a result of recent rapid changes in both demand and perception of the species. Bears are no longer considered only a nuisance species, but are in fact a valuable big-game species. Non-resident demand for hunting, as reflected by licence sales, increased almost five-fold between 1980 and 1987. This level of non-resident participation is another factor which makes management of this species unique. Unlike other game species hunted in New Brunswick, non-residents outnumber residents during bear hunting seasons and the bulk of the harvest is by non-residents. A guiding and outfitting industry has expanded to take advantage of increased non-resident demand and thus the economic and social benefits associated with bear management have a different focus than with other species.

Regardless of the source of increased demand and associated harvests, it is the "biology" of bear populations that dictates a need for more sophisticated management associated with increased exploitation. Black bears take several years to reach sexual maturity ; females breed only once every two years (sometimes at three or four year intervals) and generally are limited to one or two young per breeding period. This low reproductive potential and the need to have a large home range to satisfy food requirements, contribute to relatively low population densities when compared to other species. Also, the low reproductive potential makes bears highly vulnerable to over-exploitation. Any ability to compensate for high bear harvests through increased reproduction is limited. The rate at which recovery from low population levels can occur is also considered to be limited. The black bear is a species that can be at risk if over-exploited, both in terms of precipitous drops in numbers and

their ability to rebound following a drop in populations.

Population and harvest studies conducted elsewhere have shown that bear population problems can be indicated by changes in the age and sex structure of harvests. Generally, the young males in a population are the most vulnerable cohort to be harvested. Shifts to higher proportions of females in harvests have been associated with over-harvesting, a reflection that the more vulnerable component of the population is beginning to be "harvested out" and that a decline in bear populations is imminent. This type of trend, a shift to a greater proportion of females in the harvest, has been emerging in New Brunswick. Concurrently, the expansion of the number of bear-hunting guides and outfitters and the active marketing of New Brunswick by the Department of Tourism, Recreation and Heritage as a place to hunt bears has been continuing. These trends may be incompatible with sustaining a healthy bear population and is the prime factor underlying the need for developing and implementing a comprehensive bear management program in New Brunswick.

In the spring of 1989, a two year project to address New Brunswick's black bear management concerns was proposed (Patch, 1989) with the following four objectives:

1. To develop a strategic plan for black bear population management in New Brunswick.
2. To obtain data on hunter effort and distribution through a survey of resident and non-resident hunters and outfitters.
3. To analyze harvest, hunter effort, and biological data in order to assess bear population status and provide data for incorporation into strategic planning.
4. To provide data on black bear reproductive biology for incorporation into population models used in strategic planning. Data will be collected through field and lab studies of harvested female black bears.

Funding for this project was provided through a Federal -Provincial Planning Sub-Agreement under the guidance of the Regional Development Corporation.

The following is a report of the progress achieved after the first year of this project.

1989 Black Bear Field Project

In the spring of 1989, a project was initiated in cooperation with various Outfitters and Region 2, 4, and 5 Department of Natural Resources and Energy (DNRE) staff to collect biological information from bears killed during the spring hunting season. A total of twenty-five outfitters from the three DNRE Regions participated in the field program. Project field staff examined 250 black bear carcasses between May 8 and June 24. Reproductive tracts were collected from all female bears. As well, measurements of weight, girth and total body length were taken from each bear examined. A condition index for black bears based on the relationship between total body length and weight was developed. Hepatic (liver), renal (kidney), and muscle tissues were collected for future parasitological and heavy metal toxicology assessment. An example of the field data collection form is presented in Appendix A.

Black Bear Reproductive Data

Previous to this project, data concerning the reproductive rates of New Brunswick black bears were unknown. Examination of the collected uteri allowed for placental scar counts to be made. Placental scar counts can provide a liberal estimate of litter size (Conaway, 1955).

From research conducted elsewhere (Alt, 1981; Willey, 1981; Jonkel and Cowan, 1971) it was speculated that black bears in New Brunswick were not capable of producing cubs until at least their third year of life. Therefore only reproductive tracts from bears three years of age or older were used in determining mean litter sizes. Age of each bear was determined by cementum annuli counts of a premolar tooth collected from each bear (Willey, 1974).

Several researchers have used corpora lutea counts from

ovaries in conjunction with placental scar counts to better estimate the reproductive history of female black bears (eg. Alt, 1981; Collins, 1973; Erickson et al, 1964). In this project, reproductive tracts were collected immediately prior to the breeding season (June and July), limiting the usefulness of corpora lutea counts. Also, the ovary tissues of bears can deteriorate quickly in warm spring weather, further hampering accurate corpora lutea counts.

A total of 51 complete reproductive tracts were recovered from 92 female bears examined in 1989. Only reproductive tracts from potentially mature females (3.5 years of age or older) were examined. Analysis of the uteri of the 51 female bears indicated that 30 of the individuals had previously given birth (30/51 = 58.8%). Five females exhibited two sets of scars of different ages, indicating a pregnancy previous to the most recent scars.

Chronology of placental scar formation for the 30 productive females was as follows: two females produced scars in 1989 only; one female produced scars in both 1989 and 1987; twenty-three females produced scars in 1988 only; and four females produced scars in both 1988 and 1986. This gives a total of 35 litters from the 30 females. Average litter size based on placental scar counts from all females was determined to be 2.05 (72 scars/35 litters).

The bear reproductive tracts can further be analyzed by age of bear, but for proper comparisons the bear ages must be adjusted to correspond with the time of scar formation, not the age at which the bear was killed. Five females were of unknown age and were not used in calculating age specific litter sizes.

Based on the ages of bears, the reproductive tracts were separated into two groups; those tracts from animals less than 5.5 years of age and animals 5.5 years of age or older. The earliest reported age for producing cubs was 3.5 years (Alt, 1981; Willey, 1981) but females usually are 4.5 years of age before physically being capable of breeding. Female bears 5.5 years or older are

assumed to be behaviourally and physically mature.

Placental scar counts for the 3.5-4.5 year old breeding females (N=9) averaged 1.66 (16/9) scars per individual. Breeding females 5.5 years of age or older (N=22) averaged 2.22 (49/22) scars per individual. A summary of placental scar counts based on age of females greater than or equal to 3.5 years of age at time of scar formation is presented in Table 1.

The small sample sizes obtained for the 3.5 and 4.5 year age classes preclude statistical comparisons at this time with the 5.5 year and older age classes of females. More data will be gathered in 1990 to obtain an adequate sample size for analyses.

Examination of all uteri revealed that 27 of 41 (65.8%) females (including 3 females of unknown age) available to breed during 1987 produced placental scars in 1988. This suggests breeding synchrony may occur but New Brunswick black bear harvest data (Craig,1989) does not indicate synchronous breeding. Eight of 16 (50.0%) females 3.5 to 4.5 years old and 16 of 22 (72.7%) females older than 4.5 years produced placental scars in 1988. Information from other sources indicates that females 5.5 to 10.5 years old are the most productive cohorts of all bear age classes, therefore they should be adequately represented in healthy bear populations.

Black Bear Morphological Data

Black bear carcasses examined by project field staff were weighed whenever possible. In some instances, both live weight and dressed weight (viscera removed, hide attached) were obtained, however usually only one (live or dressed) weight was taken. Mean live and dressed weights for male and female bears examined during the 1989 spring season are presented in Table 2. Mean live and dressed weights for male and female bears, by age- class, are presented in Table 3.

Measurements of total body lengths and girths of bears

Table 1. Placental scar counts, by age at time of kill (years), for female black bears harvested in New Brunswick, 1989. (- = 0, NA = Not Applicable, Unkn. = Unknown)

Female #	Age at Kill	# of Scars	Age at Scar Formation	Year of scar Formation	Available to breed in 198
1	3.5	-	NA	-	No
2	3.5	-	NA	-	No
3	3.5	-	NA	-	No
4	4.5	-	NA	-	Yes
5	4.5	-	NA	-	Yes
6	4.5	-	NA	-	Yes
7	4.5	-	NA	-	Yes
8	4.5	-	NA	-	Yes
9	4.5	-	NA	-	Yes
10	4.5	-	NA	-	Yes
11	4.5	-	NA	-	Yes
12	4.5	-	3.5	88	Yes
13	4.5	2	3.5	88	Yes
14	4.5	2	3.5	88	Yes
15	5.5	1	5.5	89	No
	5.5	1	3.5	87	
16	5.5	1	4.5	88	Yes
17	5.5	2	4.5	88	Yes
18	5.5	2	4.5	88	Yes
19	5.5	2	4.5	88	Yes
20	5.5	2	4.5	88	Yes
21	6.5	-	NA	-	Yes
22	6.5	-	NA	-	Yes
23	6.5	1	6.5	89	Yes
24	6.5	2	5.5	88	Yes
25	6.5	3	5.5	88	Yes
26	7.5	3	6.5	88	Yes
27	8.5	-	NA	-	Yes
28	8.5	-	NA	-	Yes
29	8.5	2	7.5	88	Yes
30	8.5	2	7.5	88	Yes
31	8.5	3	7.5	88	Yes
32	9.5	2	8.5	88	Yes
33	9.5	3	8.5	88	Yes
34	10.5	1	9.5	88	Yes
	10.5	2	7.5	86	
35	10.5	1	9.5	88	Yes
	10.5	1	7.5	86	
36	10.5	2	9.5	88	Yes
37	10.5	2	9.5	88	Yes
38	10.5	2	10.5	89	Yes
39	10.5	3	9.5	88	Yes
40	10.5	3	9.5	88	Yes
41	12.5	3	11.5	88	Yes
42	12.5	4	11.5	88	Yes
	12.5	3	9.5	86	
43	Unkn.	2	Unkn.	88	Yes
	Unkn.	1	Unkn.	86	
44	Unkn.	2	Unkn.	88	Yes
45	Unkn.	3	Unkn.	88	Yes

Table 2. Mean weights for male and female black bears harvested in New Brunswick during spring 1989.

	Sex	n	$\bar{X}$ weight kg (lbs)	SD(kg)	Max. wt. kg (lbs)	Min. wt. kg (lbs)
Live wt.	M	64	75.0 (165.3)	43.81	277 (500)	18 (39.7)
	F	28	55.0 (121.2)	18.46	87 (191)	22 (48.5)
Dressed wt.	M	70	56.7 (124.7)	34.89	171 (377)	14 (30.8)
	F	41	44.6 (98.4)	18.87	79 (174)	18 (39.7)

SD = standard deviation
n = sample size

Table 3. Mean weights by age-class, for male and female black bears harvested in New Brunswick during spring 1989.

Age-class	Sex	n	Live $\bar{X}$ weight kg	SD	n	Dressed $\bar{X}$ weight kg	SD
1.5	M	5	29.2	5.0	10	23.1	6.7
1.5	F	3	23.7	5.7	4	21.0	4.0
2.5-4.5	M	32	63.1	27.3	50	53.4	25.7
2.5-4.5	F	6	49.8	18.0	12	38.3	11.9
5.5-20.5	M	20	119.1	43.3	10	112.7	31.4
5.5-20.5	F	11	66.5	9.9	16	52.9	13.4

n = sample size
SD = standard deviation

examined during the spring season were also collected. Total body length (also known as "contour length") refers to the length of the bear from the tip of the nose to the base of the tail, and was taken by following the contour of the spine with a flexible measuring tape. Girth refers to the circumference of a bear's chest and was measured immediately behind the front shoulders. Mean total body lengths and girths for male and female bears examined during the spring season are presented in Table 4. In addition, a table relating girth measurement to live weight was developed and is presented in Appendix B.

Table 4. Mean body lengths and girths by age-class, for male and female black bears harvested in New Brunswick during spring 1989.

Age-class	Sex	n	$\bar{X}$ Length cm	SD	n	$\bar{X}$ Girth cm	SD
1.5	M	13	100.7	29.5	14	64.0	8.2
1.5	F	6	110.0	6.7	6	56.2	7.5
2.5-4.5	M	80	139.6	23.9	77	84.5	25.3
2.5-4.5	F	25	136.4	11.0	23	73.3	11.2
5.5-20.5	M	28	167.3	11.9	26	104.3	25.1
5.5-20.5	F	28	143.6	11.0	28	83.9	21.9

SD = standard deviation
n = sample size

A Weight-Length Relationship For Determining Physiological Condition of Black Bears

Introduction

Nutritional status and reproductive performance have been linked in the black bear. Although females ovulate and conceive in June and early July, embryonic development is delayed until late fall following a physiological assessment of endogenous fat reserves. Female black bears which fail to achieve a minimum body weight prior to denning reabsorb the blastocytes (Wimsatt, 1963).

The relationship between physiological condition and reproductive performance directly influences recruitment. Rogers (1976) documented a 26% increase in the number of females accompanied by cubs following a year of abundant food. In Massachussetts, twenty-six of 28 females with access to high fat and carbohydrate diets produced cubs. Concomitantly, all 10 females with low carbohydrate diets failed to reproduce (Elowe and Dodge, 1989).

Successful management of black bear populations depends in part on the ability to forecast production. Consequently, managers must have at their disposal a reliable means of assessing physiological condition.

Condition indices based on deposited fat reserves have been developed for several ungulate (hoofed mammal) species. Most have relied on either a measure of kidney fat (Bear, 1971; Anderson et al. 1972a; Dauphine, 1975) or bone marrow (Allen, 1968; Neiland, 1970). However, seasonal changes in kidney size and the subjectivity associated with estimating the fat content of bone marrow limit the usefulness of these methods (Hanks, 1981).

We developed a physiological condition index for black bears based on a weight-length relationship used to correct for differences in structural size. A similar approach has been used to estimate condition in waterfowl (Owen and Cook, 1977) and

cottontail rabbits (Bailey, 1968).

Methods

Field Procedures

Black bears in New Brunswick were live trapped during 1971-79 using Aldrich foot-snares and culvert traps. Traps were checked daily and captured bears immobilized with M-99 (Zytaruk, 1979). All bears were weighed to the nearest kilogram and measured for total length from the tip of the nose to the base of tail by following the curvature of the spine with a flexible tape measure.

Analysis of the Weight-Length Relationship

We tested the dependency of weight on total body length for black bears trapped between June and August in both 1976 and 1977. With the exception of cubs, individuals in all sex-age classes were included in the analysis. A simple linear regression was performed to determine the relationship between weight and length. However, residual plots for both data sets indicated increasing variance in weight with increased length. Consequently, we employed logarithmic transformation to correct for heteroscedasticity (Zar, 1984). The regression of body weight on total length was modelled exponentially.

Results and Discussion

Correlations of weight and length were highly significant ($P<0.001$) for both 1976 ($R_2=.85$, $N=65$) and 1977 ($R_2=.85$, $N=47$). Slopes and intercepts of the weight-length models did not differ between years ($P<.05$). We present the regression equation associated with 1976 because of the larger sample of bears captured during this period:

$$\text{Weight} = e^{(.640782 + .0226479\ \text{Length})}$$

Our approach to deriving a condition index from a weight -length relationship followed Bailey (1968) who modeled condition as the quotient of body weight/total length, the morphological measure of structural size. Solving the regression coefficient of the weight-length model produces the equation:

$$(CI) \quad .0226479 = \frac{\text{Ln Weight(kg)} - .640782}{\text{Length(cm)}}$$

The right side of this equation is suggested for calculating the relative physical condition of black bears in New Brunswick.

Although the equation was developed from a sample of live bears, field dressed weights can be used to estimate condition by converting them to live mass using appropriate correction factors. By obtaining a fall sample of black bear weights managers can determine a mean value of population condition. These estimates can be compared between years as a means of monitoring changes in habitat quality and expected production.

New Brunswick Black Bear Hunter Survey

As part of the 1989 Black Bear Project, it was determined that a hunter survey would be the most effective method to secure data on hunter effort and distribution in New Brunswick. As well, this survey would document the economic benefits generated from sport-hunting of black bears and provide an estimate of wounding rate and the success rates of various hunting methods.

At the end of the 1989 spring bear hunting season, survey questionnaires were sent to 1868 of the 2470 hunters who had purchased licences. Six hundred and two licences did not have legible or complete addresses available. This sample represented 76% of all spring bear hunters. Surveys were sent to 1452 of 1852 non-resident hunters and 416 of 618 New Brunswick residents. Overall response rate was 48 percent (888/1868); 48% for non-residents (711/1452) and 45% for residents (187/416). Surprisingly, response to the survey was greater for non-residents than residents, even though only residents were supplied with prepaid return envelopes. An example of the survey form and accompanying letter is shown in Appendix C. Survey questionnaires were also sent out to licensed hunters at the end of the 1989 fall bear hunting season. Returns are still arriving and analysis of these data is planned for March. Participants hunting the fall season may have different effort and distribution patterns than those who hunt the spring season.

The following is a summary of the questions and responses to the survey questions in the order that they appeared on the questionnaire.

Question 1: Did you hunt bear in New Brunswick in 1989?

Response: 94% of respondents indicated that they hunted the 1989 spring season after having purchased a bear licence. The 6% who did not hunt after purchasing a licence cited illness, work commitments, and family matters as reasons for not hunting.

Question 2(A): Prior to 1989, how would you have rated your hunting skills?

Response: Prior to 1989, 61% of respondents rated their hunting skills as very experienced, 36% as having some experience and 3% as having no hunting experience. Respondents reporting having no hunting experience had a lower success rate (19%) than respondents indicating a higher skill level.

Question 2(B): Prior to 1989, how would you have rated your knowledge of black bear behaviour and ecology?

Response: 43% of respondents considered their knowledge of black bear behaviour and ecology was good, 43% felt it was fair and 14% felt they had very limited knowledge. The relatively large percentage of respondents indicating fair to limited knowledge of black bear behaviour and ecology underlines the general public's lack of knowledge about this species.

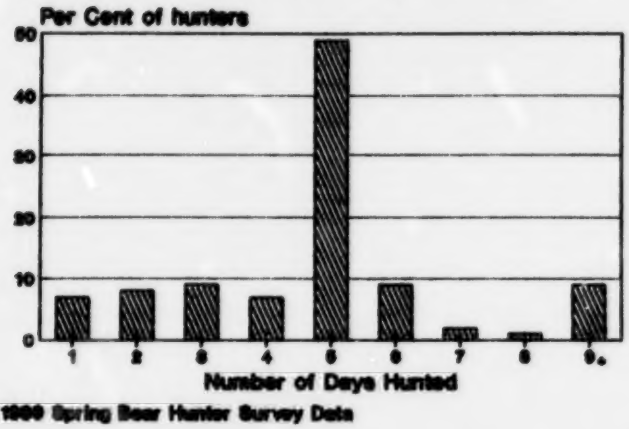
Question 4(A): What date did you start hunting?

Response: 3% of respondents hunted in the month of April, 64% in May and 33% in June. April is the least desirable month to hunt black bear in New Brunswick. Many areas still have appreciable amounts of snow in the woods and tertiary roads are in poor condition. June is considered by many hunters to be too warm for hunting. The quality of the bear's pelt is beginning to deteriorate also.

Question 4(B): How many days did you hunt black bear? (Include part of a day as one day hunted)

Response: The distribution of the number of days that respondents reported to have hunted during the 1989 spring bear season is shown in Figure 1.

Figure 1.
Number of Days Hunted/Hunter



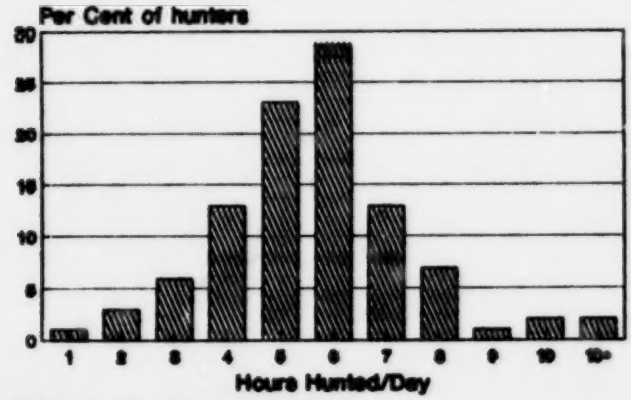
• 1989 Spring Bear Hunter Survey Data

Over 75% of hunters who indicated that they hunted less than 5 days were non-residents. The typical non-resident hunt is a 5 day package and this explains why 49% of hunters hunted that long. Those who hunted less were usually hunters who stopped because they were successful.

Question 5: During your bear hunt, approximately how many hours per day did you actually spend bear hunting?

Response: Analysis of the responses to this question indicate that spring bear hunters average 5.7 hours of hunting time per day hunted.
The distribution of hours spent hunting per day is presented in Figure 2.

Figure 2.
Distribution of Hours Hunted/Day



• 1989 Spring Bear Hunter Survey Data

Question 6: Previous to 1989, had you hunted bears in New Brunswick?

Response: In response to the question "Previous to 1989, had you hunted bears in New Brunswick?", only 40% of non-residents indicated that they had previously hunted bears in New Brunswick. Meaning conversely, that 60% of the 1989 spring non-resident hunters were hunting bears here for the first time.
73% of resident hunters who responded said they had hunted bears previous to 1989.

Question 7: What hunting method(s) did you use to hunt bear in 1989?

Response: Stand with bait was the method used by 94% of the hunters responding. 4% reported the use of a stand without bait, 5% used the stillhunting technique with 2% using "other" various methods to hunt bears. 4.3% of hunters responding reported using a combination of 2 or more of the above hunting methods. The most common combination involved still hunting in conjunction with a stand with bait and was used by 3% of hunters reporting.

Question 8: What hunting instrument(s) did you use to hunt bear in 1989?

Response: In response to a question about the type of hunting instrument used by the hunter, 80% of respondents indicated they used a rifle, 4% used a shotgun, 17% used a bow and 3% used primitive firearms. 4% of all respondents reported using 2 or more of the above hunting instruments in combination - over half of this amount being a rifle used in conjunction with a bow.

Question 9: How many live bears did you see while hunting?

Response: A total of 823 respondents reported that they saw 1530 live bears while hunting. This occurred in 4230 days of hunting by the 823 respondents, therefore one bear was sighted for every 2.8 days hunted. Of the 1530 live bears seen, 62% were adults, 17% were adults with cubs, 11% were cubs alone and 10% were of unknown age.

Question 11: Indicate how many bears you possibly wounded but were unable to recover.

Response: 93.4% of survey respondents indicated that they did not wound any bears that they could not recover, 6.6% reported that they wounded 1-2 bears. No respondents reported wounding 3 or more bears. Respondents reporting no previous hunting experience had a 50% higher wounding rate than respondents reporting greater levels of skill.

Question 12: Did you kill a bear in New Brunswick during 1989?

Response: 41.9% (372/888) of respondents reported that they did indeed kill a bear during the 1989 spring season. This answer provides an indication of response bias present in this survey. A total of 775 bears were registered by 2470 hunters during the 1989 spring season, therefore 31% (775/2470) were successful. Assuming the surveys were randomly distributed between successful and unsuccessful hunters, surveys would be received by 579 successful and 1289 unsuccessful hunters, respectively. Responses were received from 372 of the assumed 579 successful hunters sent surveys (65%) and from 516 of the assumed 1289 unsuccessful hunters sent surveys (40%). Clearly, successful hunters have a higher response effort.

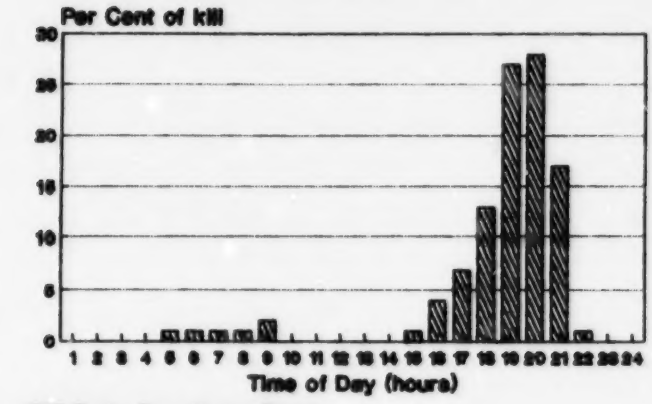
Question 12(A): Was your harvested bear a adult female, adult male, young female, young male?

Response: Of the 350 respondents who reported killing a bear during the 1989 spring season, 27% reported the harvest of an adult female, 15% the harvest of a young female, 41% the harvest of an adult male and 17% the harvest of a young male. This closely reflects the actual sex ratio of bears registered during the 1989 spring season; 61% males : 39% females (Craig, unpubl. data).

Question 12(B): What time of day was your bear killed (to the nearest hour)?

Response: The distribution of the times of kill (over 24 hours) for the bears reported harvested in this survey are presented in Figure 3. Most respondents hunted from late afternoon until dark. Few hunters were active in the morning hours.

Figure 3.
Distribution of Time of Kill



* 1989 Spring Bear Hunter Survey

Question 12(C): What part(s) of the bear did you make use of?

Response: In response to a question on what parts of the bear were utilized, 96% of the hunters responding reported using the hide (pelt). The meat was used by 68% of the respondents, the skull by 66% and miscellaneous "other" parts were used by 6% of the responding hunters. The most common "other" parts were the gall bladder, teeth and claws. Most respondents (81%) reported the utilization of several parts of the bear.

Question 13: Previous to 1989, had you killed a bear in New Brunswick?

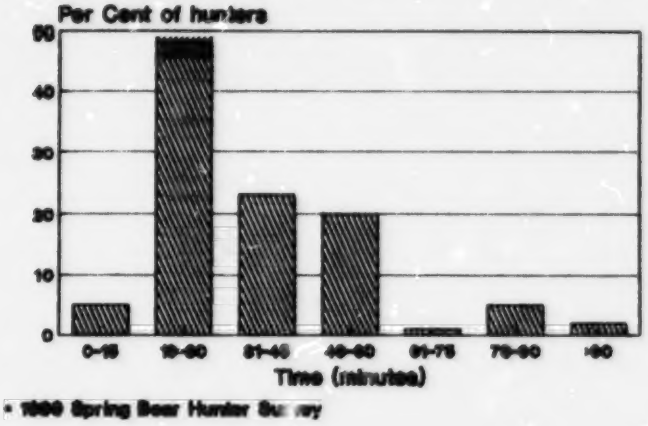
Response: 23% of non-resident respondents indicated that they had killed a bear in New Brunswick previous to 1989. 38% of resident respondents indicated that they had killed a bear in New Brunswick previous to 1989. The high incidence of return business from non-resident hunters appears to indicate their satisfaction with their New Brunswick hunting experience.

Question 14: Approximately how long did it take you (in minutes) each day to reach your hunting area?

Response: A breakdown of the travel times (minutes) required to reach their hunting destinations as reported by survey respondents is shown in Figure 4. The increased competition for the bear resource has most likely led to outfitters having to travel longer distances to find land not previously hunted.

Figure 4.

Travel Times to Reach Hunting Area



* 1999 Spring Bear Hunter Survey

Question 15: Did you use the services of an Outfitter to hunt bear?

Response: 84% of survey respondents reported that they used the services of an outfitter to hunt black bear in New Brunswick. Less than 1% of New Brunswick residents used the services of an outfitter.

Question 15(A): How would you rate the overall black bear knowledge of your Outfitter?

Response: Hunters who used the services of an outfitter to hunt black bear were asked to rate the outfitter's hunting knowledge and background.

- 72% felt that their outfitter had excellent qualifications
- 19% felt that their outfitter had good qualifications
- 6% felt that their outfitter had acceptable qualifications
- 3% felt that their outfitter had poor qualifications

Question 15(B): Before hunting, did your outfitter explain to you the game laws pertaining to black bears?

Response: 95% of respondents who hunted with an outfitter felt that he adequately explained the game laws relating to black bears to them.

Question 15(C): Before hunting, did your outfitter adequately prepare you for what to expect during your bear hunt?

Response: 92% of respondents felt that their outfitter adequately prepared them for what to expect on their hunt. 4% of respondents were undecided.

Question 15(D): Regardless of whether you killed a bear or not, did your bear hunting trip live up to your expectations?

Response: 86% of respondents felt that their 1989 hunting trip/season lived-up to their expectations. 4% of respondents felt that their expectations were unfulfilled. An additional 4% were undecided. There was no clear indication of why the hunt failed to live up to some hunter's expectations; however, 86% of those expressing dissatisfaction were unsuccessful in killing a bear.

Question 16: Approximately how much money (in Canadian $$) did you spend in New Brunswick on your hunting trip? (Do not include license fees)

Response: Survey participants were asked to provide estimates of the money they spent on new equipment, food and beverages, miscellaneous expenses, travel and accommodations during their 1989 spring hunt in New Brunswick. Values are expressed in Canadian dollars. For those respondents who did not break-down their expenses but instead listed a lump sum, a separate category designated Total Expenses was created. The total for each category as well as per individual is presented below with residents and non-residents separated.

	Non-Resident		Resident	
Category	Total $	$ Per Individual	Total $	$ Per Individual
New Equipment	21,360	34	6,060	47
Food & Beverages	52,285	82	3,335	26
Miscellaneous	48,928	77	3,895	31
Travel	50,450	79	6,855	53
Accommodations	296,958	468	2,480	19
Total Expenses	49,420	988	2,100	1050
TOTAL	519,401		24,725	

According to survey respondents, non-resident bear hunters spent an average of $754 in Canadian currency during their 1989 spring bear hunt.

Resident bear hunters spent an average of $192 on material and activities related to their hunt.

Extrapolation of these spending figures to actual spring bear licence sales provides a figure for gross expenditures by hunters during the spring season.

Non residents	1,852 x $754 =	$1,396,408
Residents	618 x $192 =	$ 118,656
	Total	$1,515,064

Similarly, the revenue generated from licence sales can also be calculated.

Non residents	1,852 x $50 =	$92,600
Residents	618 x $25 =	$15,450
	Total	$108,050

Question 17: On the map provided, please shade in the approximate area in which you hunted bears in the season indicated in Question 3.

Response: This question determines which wildlife management zone (WMZ) the respondent hunted in and gives a much needed index of hunter distribution. The following table presents hunter and kill data on a zone basis. The column titled C.U.E. represents catch per unit effort. In this situation, catch is represented by number of bears killed and the unit of effort is the total days hunted in each zone.

Table 5. Distribution of black bear hunters and hunter effort for each Wildlife Management Zone (WMZ), spring 1989, New Brunswick.

WMZ	Number of hunters	Total Days Hunted	Number of bears killed	$\bar{X}$days/hunter	C.U.E.
1	8	52	5	6.5	.10
2	4	48	0	12.0	0.0
3	5	30	1	6.0	.03
4	15	124	8	7.8	.06
5	14	61	8	4.4	.13
6	38	161	18	4.2	.11
7	40	170	26	4.3	.15
8	11	46	3	4.2	.07
9	2	17	2	8.5	.12
10	38	184	11	4.8	.06
11	60	260	23	4.3	.09
12	37	149	24	4.0	.16
13	13	80	7	6.2	.09
14	4	71	1	17.8	.01
15	103	486	43	4.7	.09
16	135	607	47	4.5	.08
17	19	90	8	4.7	.09
18	10	81	3	8.1	.04
19	5	50	1	10.0	.02
20	81	408	30	5.0	.07
21	58	308	34	5.3	.11
22	13	104	6	8.0	.06
23	15	86	7	5.7	.08
24	24	129	11	5.4	.09
25	3	34	1	11.3	.03
TOTAL	756	3836	328		

Black Bear Population Model

Most population models use estimates of animal abundance from one time and place to predict how that population will respond to various natural and man-induced (harvest) influences. Several methods can be used to estimate population size for a given time and area. The most accurate method is an intensive, long-term, mark-recapture program for each population or management zone under investigation (Pelton, 1978). For most wildlife management agencies the costs of implementing a thorough mark-recapture program are prohibitive.

A second, though less accurate method of population estimation developed by Paloheimo and Fraser (1981), involves the calculation of an estimated harvest rate from sex and age data. Based on the calculated harvest rate for males and females respectively, an estimate of population size can be derived. Two additional inputs are required for this procedure: 1) an estimate of annual hunter effort per area examined, and 2) the total number of bears harvested annually per management area. The first is available through the bear hunter survey; the second from mandatory registration data. Population estimates for each Wildlife Management Zone (WMZ) (Appendix D) are possible if annual harvest sample size is adequate ($N > 20$). The Paloheimo and Fraser (1981) method is currently used by several management agencies in the eastern United States as a key component of their black bear management programs.

Having a good estimate of population size and population sex and age structure of an area allows the development of a dynamic model that can predict population responses to various influences over time.

Model Inputs

For black bears, population dynamics are driven primarily by the biological parameters that affect females. The

rate of reproduction is the key factor responsible for population growth or decline.

Age-Specific Reproduction Rate

Reproduction by females is partly influenced by age, making the collection of age-specific reproductive data a necessity. Also important is the age at which females first breed. Field collection of reproductive tracts from harvested or vehicle killed female bears provides values for these two factors. Details of the collection of reproductive tracts from the 1989 spring season are presented elsewhere in this report.

Breeding Interval

Under ideal conditions, female bears should be capable of breeding once every two years, but some studies (Jonkel and Cowan, 1971) have shown that females frequently have longer periods between pregnancies. A technique for examining cementum annuli of premolar teeth collected from female bears (Garshelis et al, 1988) has shown that cementum lines can be a historic record of past breeding. In New Brunswick, the registration process requires collection of a premolar tooth, thereby providing the samples necessary for such an investigation.

Late Summer-Fall Mast (Food) Production Index

The reproductive status of sexually mature female bears have been shown to be the result of their nutritional condition in late fall (Wimsatt, 1963). Good quality habitats are better able to provide the extra nutritional requirements of pregnant females prior to hibernation and thereby strongly influence reproductive performance. Currently, neither an objective nor a subjective measure of annual mast yield (i.e. bear habitat quality) is undertaken in New Brunswick. Given the powerful influence of early-fall hard (ie. nut) and soft (ie. fruit and berry) mast on the reproductive performance of female bears, an estimate for mast

yields of several important plant species has been proposed (Appendix E) to provide an objective index of annual change in bear habitat quality for management zones.

Sex and Age-Class Structure

Estimates of the current sex and age-class structure of a population or management unit provide the starting structure for any population model. These data are routinely collected through mandatory registration procedures. While the structure of the harvest does not equal the structure of the population (due to differences in vulnerability to hunting mortality in different sex and classes), some inferences can be made. Beginning in the Spring of 1990, bear registration data will be recorded on a WMZ basis. Sex and age-class data are also the driving variables for the Paloheimo and Fraser (1981) model that estimates harvest rate and thereby population size.

Natural Mortality

No data are currently available on the amount of natural mortality incurred annually by black bears in New Brunswick. Other studies (McLaughlin, 1986; Bunnel and Tait, 1981) have determined estimates of natural mortality for cubs, sub-adults and adults, separately by sex. These estimates are relatively consistent and reasonable, therefore they may be applied to New Brunswick black bear populations; thus a separate investigation of natural mortality is not warranted at this time.

Hunting Mortality

Estimates of bear hunting mortality can be made based upon the sex and age-class structure of the legal harvest. Hunting mortality is strongly influenced by sex of bears. Behavioural patterns can be quite different between male and female bears. Also, the age of a bear (adult or subadult) influences its vulnerability to hunting. Estimates of hunting mortality are

available from both the scientific literature and the sex and age-class structure of annual harvests.

Hunter Effort/Hunter Distribution

Previous to 1989, hunter effort could only be roughly estimated from licence sales to resident and non-resident bear hunters. Hunter distribution was not determined, although it could be crudely estimated by comparing licence sales among DNRE District offices. In 1989, a bear hunter survey was initiated in an effort to obtain reliable data on hunting effort and characteristics of bear hunters. Accurate data are now available for hunter effort (hunter-days) and hunter distribution on a WMZ basis. Because hunters are not predictable, (particularly non-residents) and their movements are subject to change by social and economic pressures, a periodic survey of hunter effort and distribution is necessary.

Season Length and Timing

Setting the length and timing of bear hunting seasons is the one management tool (with the exception of bag-limit) that most affects sex and age-class structure of the harvest, as well as total population size. It is these components that directly or indirectly influence almost all other model components. Knowing past histories of bear hunting seasons for an area and setting the length and timing of future seasons allows for prediction of harvest levels based on different harvest strategies.

Hunting Options

Two factors under direct control of the hunter affect his/her success; the hunting method and the hunting instrument used. The varying success rates of these two factors allow the resource manager to control the harvest through special seasons and/or other constraints placed on hunters. Prior to and including 1989, the method of hunting and instrument used were collected through mandatory registration procedures. However, this system

of reporting only provides data from successful hunters, thereby potentially giving a biased representation of less successful hunting methods and instruments. In 1989, a bear hunter survey was conducted to address these same questions to both successful and unsuccessful hunters. The results of the survey are presented elsewhere in this report.

Black Bear Management Plan Development

The key to managing any wildlife species successfully is a long-term plan which includes the framework for making management decisions. Currently, the goal of a black bear management plan for New Brunswick is to produce a sustainable harvest of 1000 bears annually. This plan may have alternate goals, such as producing "X" number of hunter-days per season or maintaining a minimum success rate for hunters, if objectives change.

The black bear presents an unusual management problem in that most of the demand for the resource currently comes from outside the province and the demand is not very firm in either time or space. Prediction of the future demands and position of a group of hunters not bound by geography to any particular area of New Brunswick is extremely difficult. Predictions are best based on trends from the recent past.

The most troublesome problem is the uncertain status of the size of the New Brunswick black bear population. Presently no objective measure of population size or distribution is available. The level of our current annual harvest may not be detrimental except that the harvest is confined to relatively distinct areas of the province. A declining age structure for some of these areas may indicate overharvest and result in declining populations.

Essentially, what is needed is an inventory of black bears in the province. While this is not possible, there are several techniques by which population size can be estimated. Population estimates can be calculated separately for some wildlife management zones but others lack sufficient amounts of data for individual analysis. A population estimate so derived becomes the basis for future dynamic modelling predictions.

Preliminary data from the 1989 Black Bear Field Project indicates that New Brunswick black bears' earliest breeding can

occur at 2.5 years of age, produce cubs at age 3.5 years and some bears are capable of breeding every two years. Placental scar counts indicate annual fecundity rate is approximately 1.11. Use of a simple model developed by Bunnell and Tait (1981) indicates that New Brunswick's black bear population could sustain an annual mortality rate of approximately 20 percent. This rate includes all forms of natural and man-induced (hunting) mortality.

Use of a dynamic population model with a population estimate from a specific management unit allows for a prediction of subsequent population growth or decline.

Adjustments of age-specific reproductive rates within the model should be accomplished by monitoring annual mast production. Annual changes in mast production can affect recruitment rates within a population the following year.

Total numbers of bears harvested, killed by vehicles and killed as nuisance animals in each management unit annually should be monitored. When total kill approaches somewhat less than 20% of the estimated population size, action will have to be taken to reduce the annual harvest for that management area. Such action may take the form of shortening the length of the season, restricting the use of certain hunting methods or instruments, or setting specific quotas.

Information from other sources are necessary to reinforce confidence in population predictions generated by the dynamic model and harvest data. Hunter effort must be monitored province-wide to document success rate changes and the amount of hunter pressure within management areas. Also a method of monitoring animal activity (i.e. bear visitation rates at scent stations) should be used periodically to detect population trends (increasing or decreasing abundance) as a check on the population predictions of the dynamic model.

Resident hunter effort is likely to increase in the future. Any management plan will have to be adaptive and capable of addressing increased hunting pressure and demand, while ensuring

the sustainability of bear populations.

Estimating Abundance of Black Bears

A variety of methods have been used to estimate the abundance of black bear populations across its range. Most approaches have been expensive, time consuming and generally limited to a relatively small geographic area, making their application for widespread use difficult.

However, the technique of using scent station visitation to index black bear abundance has been shown to be a method that is repeatable, relatively inexpensive, and reliable (Lindzey et al, 1977). The procedure involves establishing a series of scent station lines located several kilometres apart in areas considered to be good black bear habitat. The ground around each scent station is prepared so that an animal visiting the station will leave visible tracks. Once established, an observer checks each station daily and records presence or absence of tracks. Details on the scent station index methodology are presented in appendix F.

In practice, several scent station lines would be established and operated for each wildlife management zone (WMZ). Although scent station procedures do not estimate actual population size, they do provide an index that can be used to compare relative abundance among areas and between years.

An index of abundance is particularly useful for monitoring population changes within a wildlife management zone in response to changing hunting and harvest strategies. Used in conjunction with a predictive population model, the scent station index would allow greater confidence when interpreting population responses to changes in harvest or management strategies.

Index of Mast Production

Nutritional status and reproductive performance have been linked in the black bear. Although females conceive in June and early July, individuals which fail to achieve a minimum body weight prior to denning reabsorb the blastocytes (Wimsatt, 1963). The ability to physiologically assess fat reserves has developed in response to the negative energy balance imposed by hibernation. During this period, female black bears must rely on acquired fat reserves for both maintenance of basal metabolic functions and lactation.

Weight gain in black bears normally occurs during late summer and fall (Nelson et al, 1983). During this period nut and berry species (herein defined as mast crops) are predominant in the diet of black bears (Graber and White, 1983; Beeman and Pelton, 1980). These food items are typically high in fat and energy content (Landers et al. 1979).

Annual variation in bear productivity has been correlated with fluctuations in fall mast crops. Rogers (1976) documented a 26% increase in the number of females accompanied by cubs following a year of abundant food. Female black bears in Tennessee failed to reproduce in years characterized by the failure of fall mast crops (Eiler, 1981). In Massachusetts, twenty six of 28 females with access to abundant fall foods produced cubs (Elowe, 1987).

Mast crops provide a food source high in fat energy content during the period black bears are accumulating body reserves. Variation in the annual production of mast is reflected in reproductive success. Forecasting recruitment rates of black bear populations requires that we estimate changes in mast abundance.

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APPENDICES

APPENDIX A

FIELD DATA COLLECTION FORM

Bear #: _____

NEW BRUNSWICK BLACK BEAR HARVEST - FIELD PROJECT

Observer: _____

Date of Kill: ___/___/___
D M Y

Location of Kill: _____ (County) _____ (Parish)

_____ (Map Book Grid Ref.)

Sex of Bear: ____ If Female - wet or dry? ___

- Reproductive tract removed? ___

Estimated Age: Adult - Ylg. - Cub (Circle)

Premolar Tooth Extracted? ___ (Y-N?)

Actual Dressed Weight: _____ (Kg)

Total Length (nose tip to last vertebrae in tail, following curvature of body) _____ (cm)

Girth (immediately behind fore legs) _____ (cm)

Type of Kill: Hunt___ Vehicle___ Poach___

Other_____

Type of Bait Used: _____

Hunter Licence #: _____

Registration Tag #: _____

Kidney tissue collected? ___ (Y-N?)
Liver tissue collected? ___
Muscle tissue collected? ___

Outfitter Name (if applicable): _____

==========

NOTE LABEL ALL SPECIMENS BY (1) IDENTIFYING THE TISSUE, (2) DATE, AND (3) REGISTRATION TAG NUMBER.

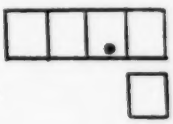
Example: Bear Kidney
21 May 1989
Reg. # 04542

COMMENTS

(Parasites, scars, animal condition, baiting procedures,colour of coat, etc.....)

OFFICE USE ONLY

ACTUAL AGE: _____ (Yr)



NUMBER OF PLACENTAL SCARS: _____

CHEMICAL ANALYSIS RESULTS:

Kidney _____

Liver _____

Muscle _____

APPENDIX B

PREDICTING BODY WEIGHTS FROM GIRTH MEASUREMENTS IN BLACK BEARS

Predicting Body Weights From Girth Measurements In Black Bears

Introduction

High correlations between chest girth measurements and body weight have been reported for several black bear populations (Payne 1976, Cherry and Pelton 1976, Lecount 1977, Alt 1980). However, interpopulation variation in body proportions precludes the development of one equation for the species (Swenson et al, 1986). Consequently, we developed a relationship between total body weight and girth from a sample of black bears trapped in New Brunswick.

Methods

We documented weight and girth measurements of black bears live trapped in New Brunswick between June and August 1977. A simple linear regression was performed to determine the dependency of total body weight on girth.

Results and Discussion

Correlations of weight and girth were highly significant ($P<.001$) ($R^2=.92$, $N=48$). We developed a table (Table 6) for predicting live weights of black bears based on the following regression equation:

$$\text{Live weight(kg)} = -102 + 2(\text{girth(cm)})$$

Predicted weights closely approximate those obtained from a similar equation developed in Maine (Hugie, 1982)

Within specific black bear populations the age of first

reproduction is generally that at which females attain adult weight (Bunnell and Tait, 1981). Consequently, growth rate data can provide a means of estimating the mean age of first reproduction. Determining growth rates for black bear populations requires a large sample size of bear weights within age class. Because personnel do not always have access to scales, a means of estimating weight based on a measure of body size is essential Girth measurements can be taken quickly and can be supplied for the purpose of estimating weight by both DNRE staff and licensed outfitters.

TABLE 6. Weight estimates based on girth.

Girth (cm)	Kgs	Lbs	Girth (cm)	Kgs	Lbs
60	18	39.6	112	122	268.4
61	20	44	113	124	272.8
62	22	48.4	114	126	277.2
63	24	52.8	115	128	281.6
64	26	57.2	116	130	286
65	28	61.6	117	132	290.4
66	30	66	118	134	294.8
67	32	70.4	119	136	299.2
68	34	74.8	120	138	303.6
69	36	79.2	121	140	308
70	38	83.6	122	142	312.4
71	40	88	123	144	316.8
72	42	92	124	146	321.2
73	44	96.8	125	148	325.6
74	46	101.2	126	150	330
75	48	105.6	127	152	334.4
76	50	110.0	128	154	338.8
77	52	114.4	129	156	343.2
78	54	118.8	130	158	347.6
79	56	123.2	131	160	352
80	58	127.6	132	162	356.4
81	60	132	133	164	360.8
82	62	136.4	134	166	365.2
83	64	140.8	135	168	369.6
84	66	145.2	136	170	374
85	68	149.6	137	172	378.4
86	70	154	138	174	382.8
88	74	162.8	139	176	387.2
89	76	167.2	140	178	391.6
90	78	171.6	141	180	396
91	80	176	142	182	400.4
92	82	180.4	143	184	404.8
93	84	184.8	144	186	409.2
94	86	189.2	145	188	413.6
95	88	193.6	146	190	418
96	90	198	147	192	422.4
97	92	202.4	148	194	426.8
98	94	206.8	149	196	431.2
99	96	211.2	150	198	435.6
100	98	215.6	151	200	440
101	100	220	152	202	444.4
102	102	224.4	153	204	448.8
103	104	228.8	154	206	453.2
104	106	233.2	155	208	457.6
105	108	237.6	156	210	462
106	110	242	157	212	466.4
107	112	246.4	158	214	470.8
108	114	250.8	159	216	475.2
109	116	255.2	160	218	479.6
110	118	259.6			
111	120	264			

APPENDIX C

BEAR HUNTER SURVEY QUESTIONNAIRE

Dear Black Bear Hunter:

You have been selected for the 1989 New Brunswick Black Bear Hunter Survey.

We need your help to determine what effect the past hunting season has had on bear populations, and to learn more about the characteristics of our bear hunters. This information is necessary to provide good hunting opportunities in the future and to maintain bear numbers at optimum levels. Please complete the enclosed questionnaire and attached map and return it to:

Fish and Wildlife Branch
Dept. Natural Resources and Energy
P.O. Box 6000
Fredericton, NB
CANADA
E3B 5H1

** PLEASE NOTE **
Even if you did not hunt bear in 1989, please answer question number 1 and return the questionnaire to us. Please help us to avoid sending costly reminder notices. If you did hunt bear, please answer all appropriate questions on the survey form and map.

Thank you for your cooperation.

Gerald Redmond
Big-Game Project Leader
Fish and Wildlife Branch

Madame, Monsieur:

Vous avez été choisi pour participer au sondage sur la chasse à l'ours noir au Nouveau-Brunswick en 1989.

Nous avons besoin de votre aide afin de préciser quels sont les effets de la chasse de l'année dernière sur la population d'ours et nous voulons mieux connaître les caractéristiques des chasseurs à l'ours. Ces renseignements sont nécessaires afin d'offrir de meilleures possibilités de chasse pour l'avenir et pour maintenir le nombre d'ours à son niveau optimum. Veuillez remplir le questionnaire et la carte ci-joints et les faire parvenir à:

Direction de la pêche sportive et de la chasse
Ministère des Ressources naturelles et de l'Énergie
C.P. 6000
Fredericton (Nouveau-Brunswick)
E3B 5H1

REMARQUE

Même si vous n'avez pas chassé l'ours en 1989, veuillez remplir la question 1 et nous renvoyer le questionnaire, vous nous éviterez ainsi la dépense entraînée par l'envoi d'avis. Si vous avez chassé l'ours, veuillez répondre à toutes les questions appropriées du questionnaire et de la carte.

Nous vous remercions pour votre collaboration et vous prions d'agréer, Madame, Monsieur, l'expression de nos sentiments les meilleurs.

Gerald Redmond
Chargé du projet des gros gibiers
Direction de la pêche sportive et de la chasse

60-6182 (9/89)

NEW BRUNSWICK
BLACK BEAR HUNTER SURVEY 1989

Please answer the following questions carefully:

1. Did you hunt bear in New Brunswick in 1989 ? ☐ YES ☐ NO
   If NO, then you have now completed the survey. Please send it to the address below.

---

2. Prior to 1989, how would you have rated.....
   (a) Your hunting skills: ☐ VERY EXPERIENCED ☐ SOME EXPERIENCE ☐ NO EXPERIENCE

   (b) Your knowledge of black bear behavior and ecology: ☐ GOOD ☐ FAIR ☐ VERY LIMITED

3. In what season(s) did you hunt during 1989 ? ☐ SPRING ☐ FALL (BOW) ☐ FALL (GUN)

4. (a) What date did you start hunting ? _____ MONTH _____ DAY

   (b) How many days did you hunt black bear ? (Include part of a day as one day hunted.) _____ DAYS

5. During your bear hunt, approximately how many hours per day did you actually spend bear hunting ? _____ HOURS/DAY

6. Previous to 1989, had you hunted bears in New Brunswick ? ☐ YES ☐ NO

7. What hunting method(s) did you use to hunt bear in 1989 ? ☐ STAND WITH BAIT ☐ STAND WITHOUT BAIT ☐ STILL HUNT ☐ OTHER(specify)_____

8. What hunting instrument(s) did you use to hunt bear in 1989 ? ☐ RIFLE ☐ SHOTGUN ☐ BOW ☐ PRIMITIVE FIREARM

9. How many live bears did you see while hunting ? _____

   Of these, how many were: ADULTS ALONE _____ ADULTS WITH CUBS _____ CUBS ALONE _____ UNKNOWN AGE _____

10. How many bears did you shoot at but miss ? _____

11. Indicate how many bears you possibly wounded but were unable to recover. ☐ NONE ☐ 1-2 ☐ 3+

12. Did you kill a bear in New Brunswick during 1989 ? ☐ YES ☐ NO

    If YES,
    (a) Was it an : ☐ ADULT FEMALE ☐ YOUNG FEMALE ☐ ADULT MALE ☐ YOUNG MALE

    (b) What time of day was it killed ? (to the nearest hour) _____ AM _____ PM

    (c) What part(s) of the bear did you make use of ? ☐ NONE ☐ HIDE ☐ MEAT ☐ SKULL ☐ OTHER(specify)_____

13. Previous to 1989, had you killed a bear in New Brunswick ? ☐ YES ☐ NO

14. Approximately how long did it take you (in minutes) each day to reach your hunting area ? _____ MINUTES

15. Did you use the services of an Outfitter to hunt bear ? ☐ YES ☐ NO

    If YES,
    (a) How would you rate the overall black bear knowledge and hunting knowledge of your outfitter ? ☐ EXCELLENT ☐ GOOD ☐ ACCEPTABLE ☐ POOR

    (b) Before hunting, did your outfitter explain to you the game laws pertaining to black bears ? ☐ YES ☐ NO

    (c) Before hunting, did your outfitter adequately prepare you for what to expect during your bear hunt ? ☐ YES ☐ NO ☐ UNDECIDED

    (d) Regardless of whether you killed a bear or not, did your bear hunting trip live up to your expectations ? ☐ YES ☐ NO ☐ UNDECIDED

16. Approximately how much money (in Canadian $$) did you spend in New Brunswick on your hunting trip ? (Do not include license fees)

NEW EQUIPMENT	$ _____	TRAVEL	$ _____
FOOD AND BEVERAGES	$ _____	ACCOMMODATIONS	$ _____
MISCELLANEOUS	$ _____		

Comments: _____

Thank you for carefully completing this survey. Please mail to:
Fish and Wildlife Branch
Dept. Natural Resources and Energy
P.O. Box 6000
Fredericton, N.B. CANADA
E3B 5H1

For Office Use

1 ☐ 2 ☐ 3 ☐ 4 ☐☐☐ 7 ☐☐ 9 ☐☐ 11 ☐☐ 13 ☐☐ 15 ☐ 16 ☐☐☐☐ 20 ☐☐☐☐ 24 ☐☐ 28 ☐☐☐☐ 30 ☐☐☐☐ 34 ☐ 35 ☐ 36 ☐ 37 ☐☐ 39 ☐☐☐☐☐ 44 ☐ 45 ☐☐☐ 48 ☐ 49 ☐ 50 ☐ 51 ☐ 52 ☐ 53 ☐☐☐☐ 57 ☐☐☐☐ 61 ☐☐☐☐ 65 ☐☐☐☐ 69 ☐☐☐☐

60-6181 (1/89)

SONDAGE SUR LA CHASSE À L'OURS NOIR AU NOUVEAU-BRUNSWICK EN 1989

Veuillez répondre aux questions suivantes :

1. Avez-vous chassé l'ours au Nouveau-Brunswick en 1989? ☐OUI ☐NON
   Dans la NÉGATIVE, vous avez maintenant terminé le sondage. Veuillez le retourner à l'adresse indiquée ci-dessous.

---

2. Avant 1989, comment auriez-vous évalué...
   a) vos compétences à la chasse ☐BEAUCOUP D'EXPÉRIENCE ☐UN PEU D'EXPÉRIENCE ☐AUCUNE EXPÉRIENCE

   b) vos connaissances sur le comportement et le milieu de vie de l'ours noir : ☐BONNES ☐MOYENNES ☐TRÈS LIMITÉES

3. À quelle(s) saison(s) avez-vous chassé en 1989? PRINTEMPS☐ AUTOMNE☐ AUTOMNE☐
   (ARC) (FUSIL)

4. a) À quelle date avez-vous commencé à chasser? _____ _____
   MOIS JOUR

   b) Pendant combien de jours avez-vous chassé l'ours noir?
   (Compter chaque journée incomplète de chasse comme une journée) ___JOURS

5. Pendant votre expédition de chasse, à peu près combien d'heures par jour avez-vous consacrées à la chasse à l'ours? _____ HEURES/JOUR

6. Avant 1989, aviez-vous chassé l'ours au Nouveau-Brunswick? ☐OUI ☐NON

7. De quelle(s) façon(s) avez-vous chassé l'ours en 1989?
   ☐ATTENTE AVEC APPÂTS ☐ATTENTE SANS APPÂTS ☐AFFÛT
   ☐AUTRE(préciser)

8. Quels instruments de chasse avez-vous utilisés pour chasser l'ours en 1989?
   ☐CARABINE ☐FUSIL DE CHASSE ☐ARC ☐ARME À FEU PRIMITIVE

9. Combien d'ours vivants avez-vous vus pendant votre expédition de chasse? ___
   De ce nombre, combien étaient des: __ADULTES SEULS __ADULTES AVEC OURSONS
   __OURSONS SEULS __ D'ÂGE INCONNU

10. Sur combien d'ours avez-vous tiré sans les atteindre? _____

11. Indiquez combien d'ours vous avez possiblement blessés mais n'avez pas réussi à trouver. ☐AUCUN ☐1-2 ☐3+

12. Avez-vous tué un ours au Nouveau-Brunswick en 1989? ☐OUI ☐NON

    Dans l'AFFIRMATIVE,
    a) S'agissait-il: ☐D'UNE FEMELLE ADULTE ☐D'UN MÂLE ADULTE
    ☐D'UNE JEUNE FEMELLE ☐D'UN JEUNE MÂLE

    b) À quel moment de la journée a-t-il été tué?
    (à l'heure près) _____

    c) Quelle(s) partie(s) de l'ours avez-vous utilisés(s)?
    ☐AUCUNE ☐PEAU ☐VIANDE
    ☐TÊTE ☐AUTRE (préciser) _____

13. Avant 1989, aviez-vous tué un ours au Nouveau-Brunswick? ☐OUI ☐NON

14. Environ combien de temps avez-vous mis (en minutes) quotidiennement pour vous rendre à votre zone de chasse? _____ MINUTES

15. Vous êtes-vous prévalu des services d'un pourvoyeur pour chasser l'ours?
    ☐OUI ☐NON

    Dans l'AFFIRMATIVE,
    a) Dans l'ensemble, comment évalueriez-vous les connaissances sur les ours et sur la chasse de votre pourvoyeur?
    ☐EXCELLENTES ☐BONNES ☐ACCEPTABLES ☐MÉDIOCRES

    b) Avant de partir à la chasse, votre pourvoyeur vous a-t-il expliqué les dispositions des lois sur le gibier qui concernent particulièrement les ours noirs? ☐OUI ☐NON

    c) Avant de partir à la chasse, votre pourvoyeur vous a-t-il adéquatement préparé à ce à quoi vous deviez vous attendre pendant votre chasse à l'ours? ☐OUI ☐NON ☐INCERTAIN

    d) Même si vous n'avez pas tué d'ours, votre expédition de chasse à l'ours a-t-elle répondu à vos attentes?
    ☐OUI ☐NON ☐INCERTAIN

16. Indiquez la somme approximative (en dollars CA) que vous avez consacrée à votre expédition de chasse au Nouveau-Brunswick? (Exclure les frais de permis)

NOUVEL ÉQUIPEMENT	_____ $	DÉPLACEMENTS	_____ $
NOURRITURE	_____ $	HÉBERGEMENT	_____ $
DIVERS	_____ $		

Commentaires : _____

Merci d'avoir répondu à ce sondage. Veuillez l'expédier à :
Direction de la pêche sportive et de la chasse
Min. des Ressources naturelles et de l'Énergie
C.P. 6000
Fredericton (Nouveau-Brunswick)
CANADA
E3B 5H1

A l'usage du bureau seulement

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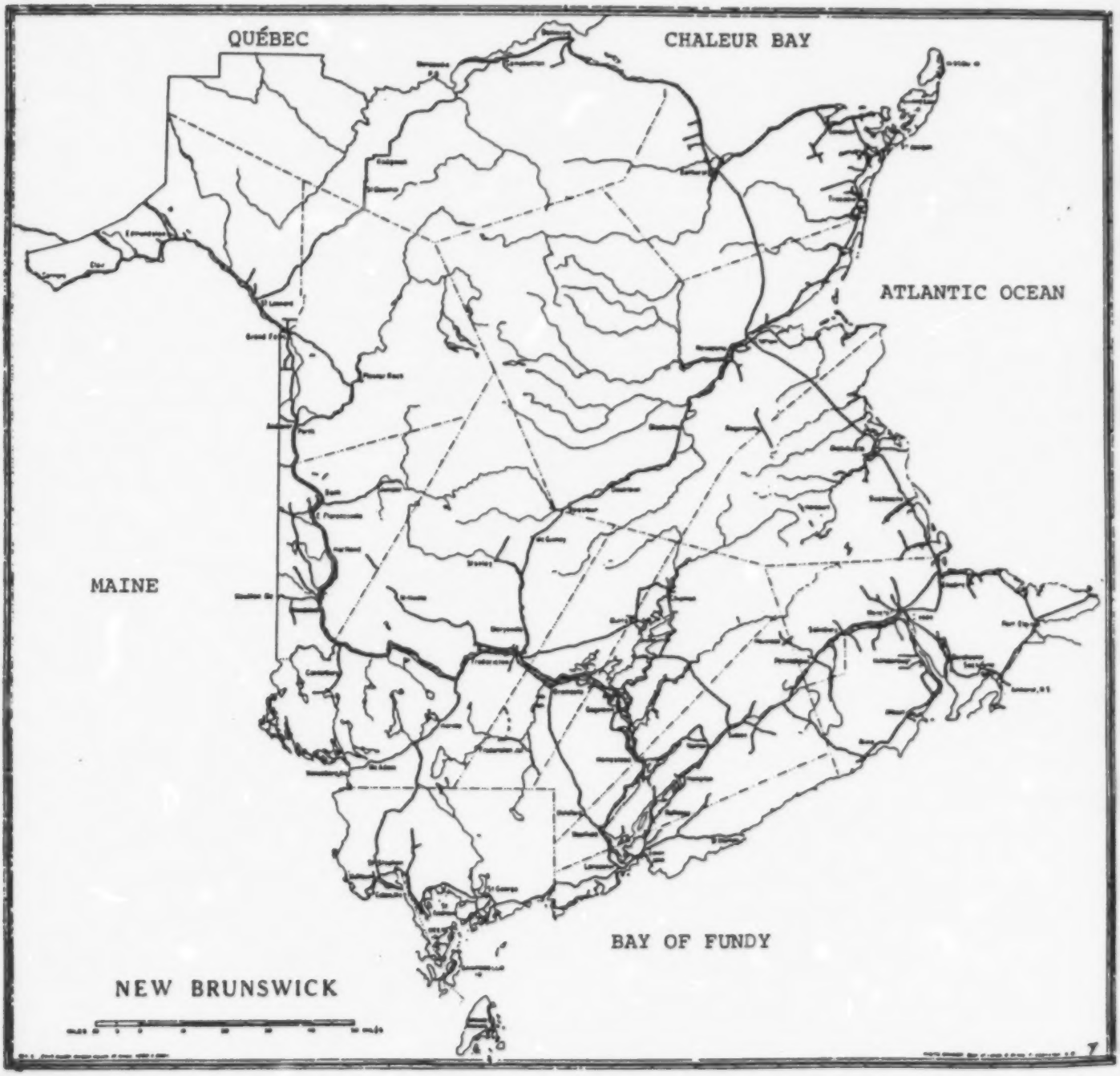
40-6131 (1989)

17. On the map below, please shade in the approximate area in which you hunted bears in the season indicated in Question 3.

73

Sur la carte ci-dessous, veuillez ombrer la région dans laquelle vous avez chassé l'ours dans la (les) saison(s) indiquée(s) à la question 3.

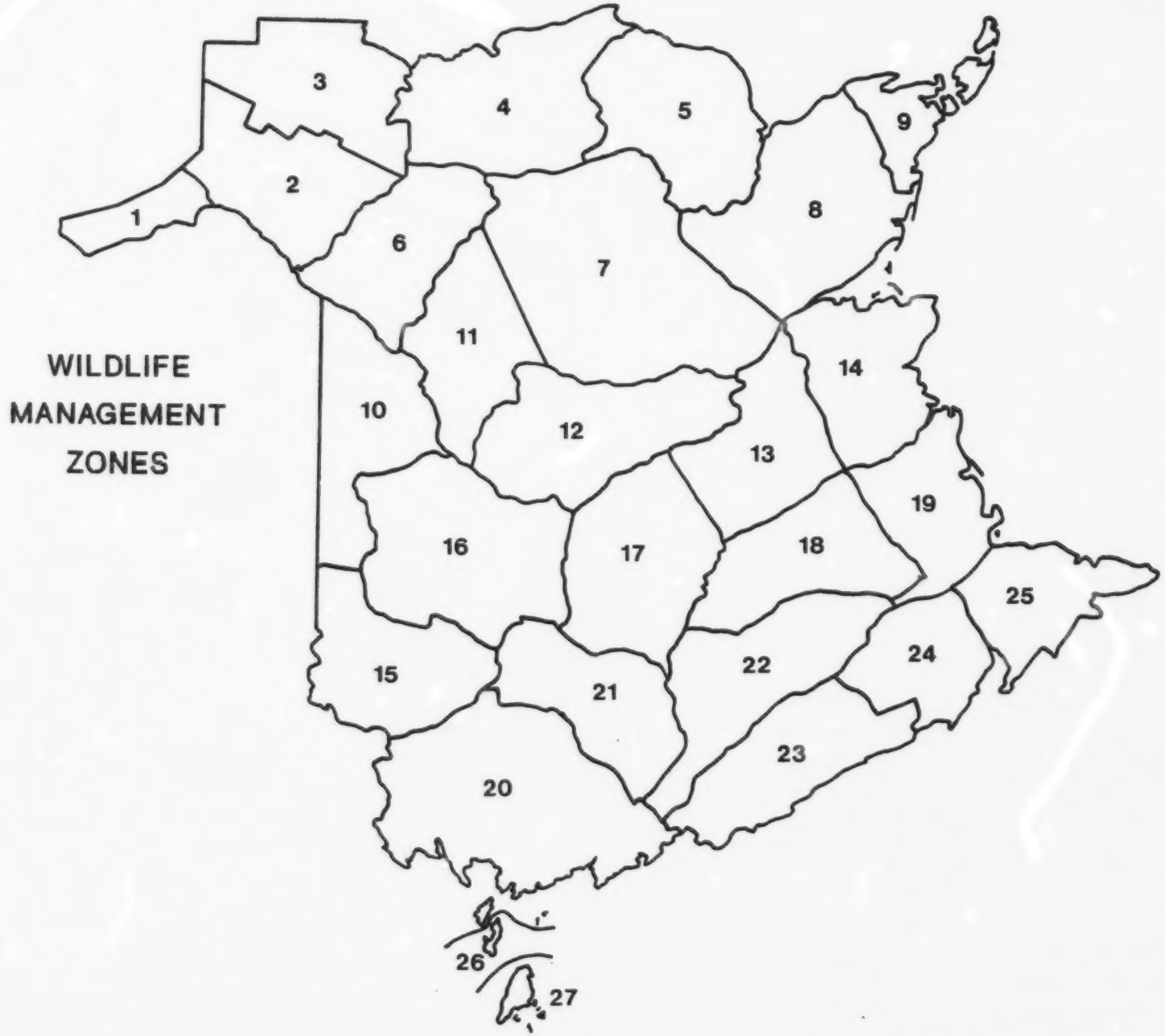


Please enclose this sheet when returning the survey form.
Veuillez retourner cette page avec le questionnaire.

60-6182 (9/89)

APPENDIX D

WILDLIFE MANAGEMENT ZONES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MANAGEMENT
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APPENDIX E

AN APPROACH TO SAMPLING MAST PRODUCTION IN NEW BRUNSWICK

An Approach to Sampling Mast Production in New Brunswick

Most tree and shrub species exhibit considerable variation in annual fruit and nut production. Table 7 illustrates the extent to which beech nut crops in southern New Brunswick fluctuated over a 7 year period.

Table 7. Beech nut production in southern New Brunswick between 1973 and 1976 as indexed by mean number of nuts per seed trap (Powell unpubl. data).

1973	1974	1975	1976	1977	1978	1979
14	13	28	65	9	32	11

Annual variation in seed production is associated with weather patterns. Cone production in western white pine (Pinus monticola) was dependant on precipitation and temperature in both the conelet and crop years (Eis, 1976). Acorn development in white oaks is associated with mean temperature in April and May (Sharp and Sprague, 1967). Weather also exerts an influence on reproduction in shrub species. Crop failures of globe-huckleberry fruit (Vaccinium globulare) were attributed to meterological events (Martin, 1988). The influence of weather on fruit and nut production precludes long term forecasts of mast crops based on reproductive cycles. Reliable estimates of mast production can only be obtained by periodic direct sampling.

Sampling Zones

Reducing sample size by minimizing variation

Wildlife management zones within the same climatic regions of New Brunswick have been aggregated into 5 distinct sampling zones to assist in the collection and interpretation of mast yield data (Figure 5). Sampling zones were determined by overlaying the province's wildlife management zones on Groenewoud's (1983) diagram of climatic regions of New Brunswick. Intraspecific variation in mast production attributable to weather should be minimized within a climatic zone. Stratifying the province into these zones will reduce the sampling effort required to estimate

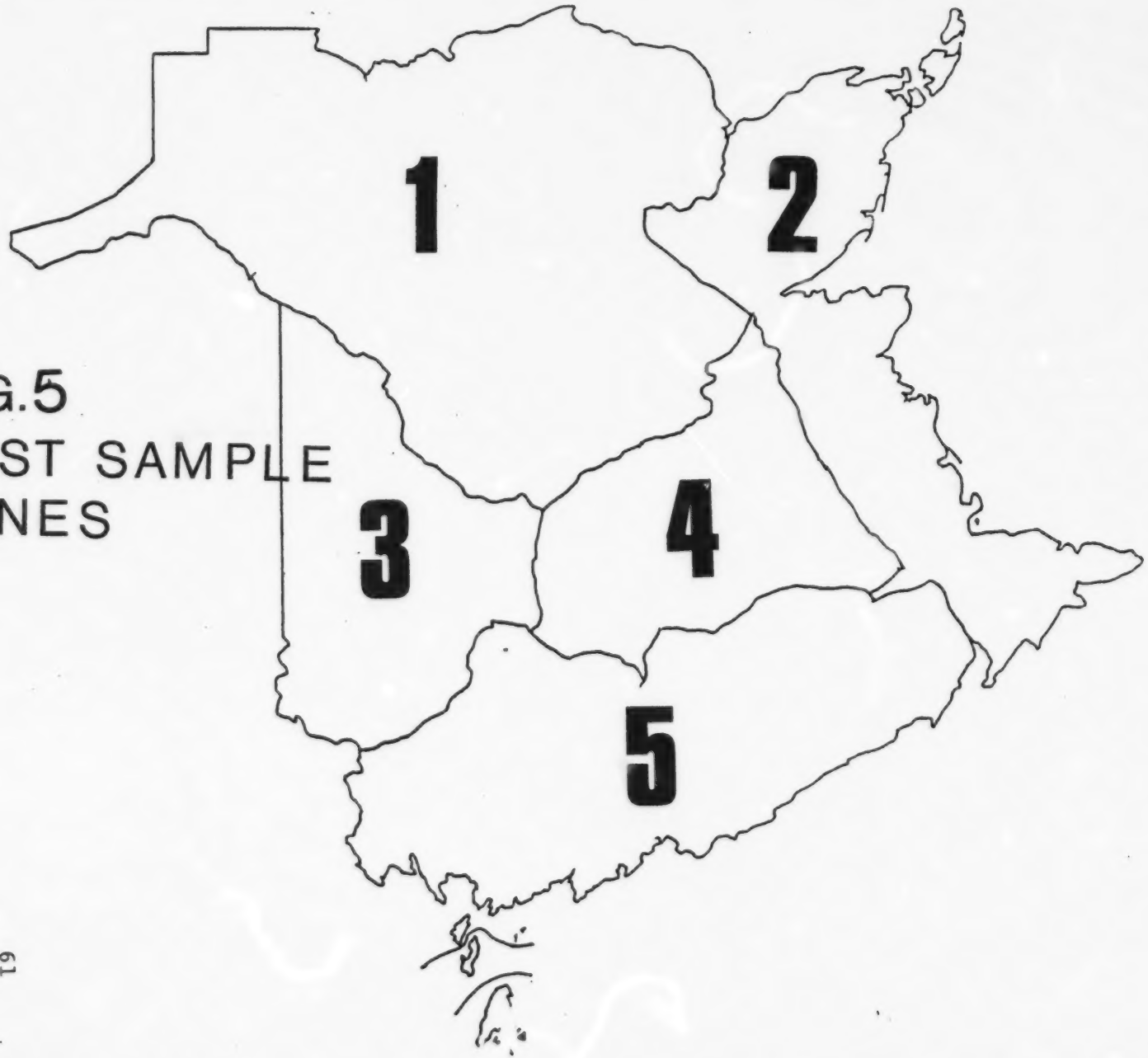

FIG.5
MAST SAMPLE
ZONES

mast yields.

As a result of differences in genotype, intraspecific variation in mast yields may be expected even within a climatic zone. Consequently, estimates of variation within a zone are required prior to a decision on sample size. For this purpose, fifteen sampling units, each corresponding to a provincial G.I.S. division, have been randomly selected within each of the 5 zones (Figure 6). Appropriate sample sizes for subsequent years will be determined following an analysis of variance (Eberhardt, 1978). The wildlife management units and the G.I.S. sampling points within each sampling zone are listed in Table 8.

Sampling Period

Studies of weight gain in black bears suggest fat reserves are obtained during the hyperphagic period of late summer and fall (Nelson et al., 1983). Consequently, sampling will be conducted during August and September to coincide with this period. Monitoring food abundance prior to these dates may fail to include mast crops upon which weight gain in black bears is primarily dependant.

Species To Be Sampled

Personnel and time constraints limit the number of mast crops that can be sampled within the province. Only plant species that have been identified as important black bear foods and which are common throughout New Brunswick are considered (Table 9). The decision to include a plant species in a sample of mast production is based on the following criteria: 1) the extent to which fruit production in a plant species has been correlated with bear productivity, 2) the chronology of fruit ripening, 3) the ease at which annual variation in seed production can be estimated. Documenting annual variation in fruit and nut production is presumed to be easier in species that form dense groups or thickets as opposed to species where individual plants are scattered.

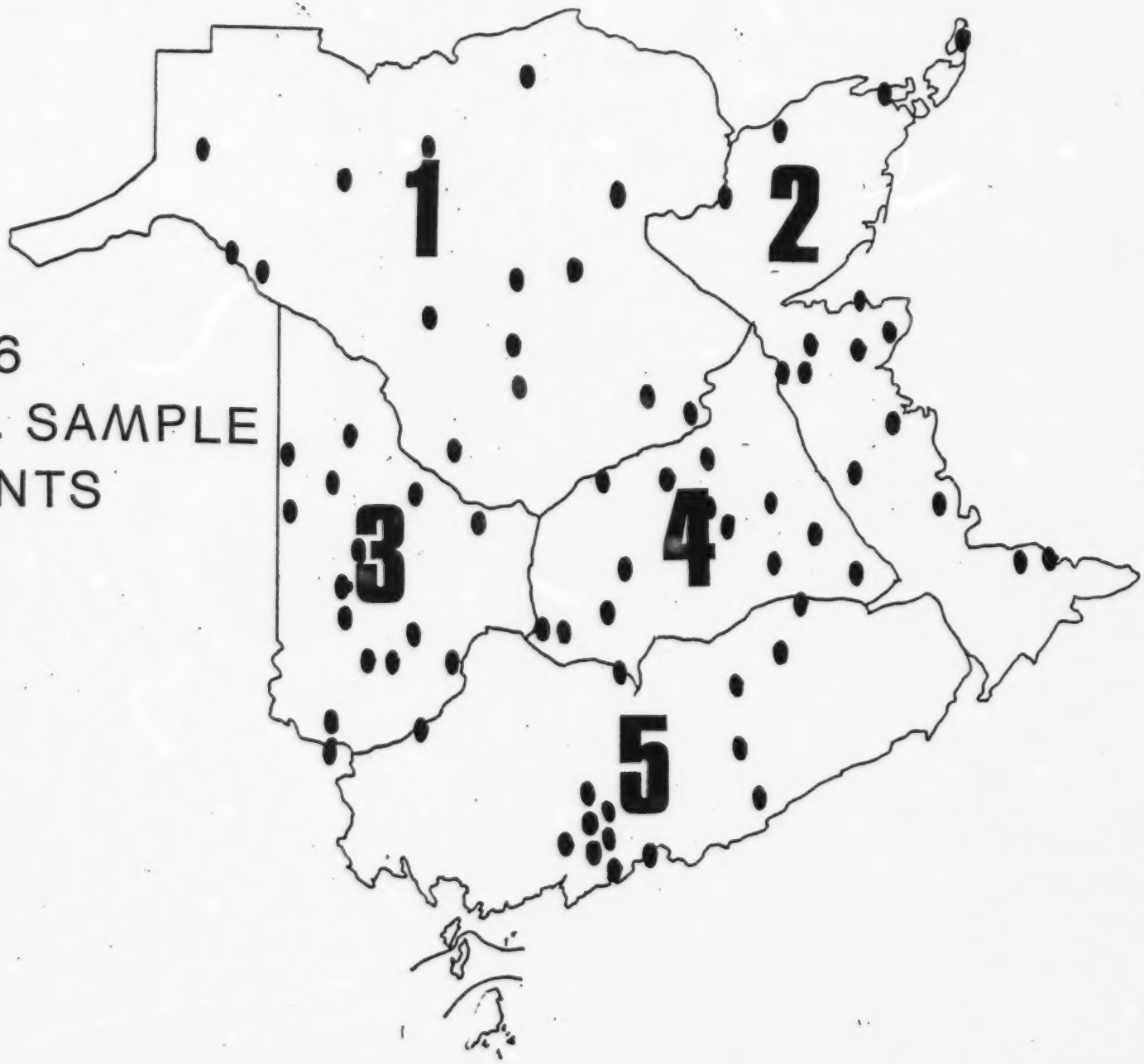

FIG.6
G.I.S. SAMPLE
POINTS

Table 8. Wildlife management areas and G.I.S. sample points included in each mast sampling zone.

Mast Sampling Zone	Management Areas	G.I.S. Sampling Points
1	1,2,3,4,5,6,7,11,12	5335,4613,4828,4129,3326,3720, 3125,3018,4238,4119,4527,5021, 5135,4531,4534
2	8,9,14,19,25	6337,7046,6414,6140,5932,6543, 6946,5817,6331,5421,6709,5733, 5833,6227,6132
3	10,15,16	3656,4050,3952,3657,3747,4041, 3737,3442,3640,4343,3844,4252, 3852,3749,3438
4	13,17,18	4940,6147,5439,5053,5240,4750, 5742,5046,4650,5345,4949,5543, 5443,5748,5944
5	20,21,22,23,24	4863,4764,5661,4864,5848,4962, 4056,5062,5165,4966,5558,5752, 4861,5554,4963

Table 9. Plant species that have been identified as important black bear foods and which are considered to be common in New Brunswick.

Plant Species	Location	Source
Vaccinium angustifolium; (Low Sweet Blueberry) Vaccinium myrtilloides (Velvet-leaf Blueberry)	New Brunswick	Zytaruk (1979)
	Vermont	Willey (1981)
	North Carolina	Landers et al (1979)
	Yukon	MacHutchon (1989)
	Tennessee	Eagle & Pelton (1983)
	Wisconsin	Graber & White (1983)
Rubus pubescens; (Dwarf Raspberry) Rubus strigosus (Red Raspberry)	New Brunswick	Zytaruk (1979)
	Vermont	Willey (1981)
	North Carolina	Landers et al (1979)
	Tennessee	Eagle & Pelton (1983)
	Wisconsin	Graber & White (1983)
Prunus pennsylvanica; (Pin-Cherry) Prunus virginiana (Choke-Cherry)	Vermont	Willey (1981)
	Manitoba	Szalai (1987)
Corylus cornuta (Beaked Hazelnut)	Vermont	Willey (1981)
	Manitoba	Szalai (1987)
Fagus grandifolia (Beech)	Vermont	Willey (1981)
Cornus canadensis; (Bunchberry) Cornus stolonifera (Red Osier)	Manitoba	Szalai (1987)
	Wisconsin	Graber and White (1983)
Aralia nudicaulus; (Wild Sarsaparilla) Aralia hispida (Bristly Sarsaparilla)	Manitoba	Szalai (1987)
Ribes glandulosum; (Skunk Currant) Ribes lacustre (Bristly Currant)	Wisconsin	Graber and White (1983)

Nine plant species from the list presented in Table 9 have been selected for sampling mast production in New Brunswick. The 9 species are listed in Table 10. All have been associated with annual variation in bear productivity, produce ripened fruit during the period black bears are accumulating fat reserves and grow in close association with conspecifics.

Failure of certain mast crops may be offset by abundant fruit and nut production in other plant species. The number of species proposed in Table 10 should ensure an adequate sample of preferred and alternate foods.

Table 10. Plant species to be included in a sample of mast production in New Brunswick.

Species	Structure	Ripening Dates
V. angustifolium (Low Sweet Blueberry)	Colonial	June-Aug.
V. myrtilloides (Velvet-leaf Blueberry)	Colonial	July-Sept.
R. strigosus (Red Raspberry)	Thicket Forming	July-Aug.
P. pennsylvanica (Pin-Cherry)	Tree Species	July-Sept.
P. virginiana (Choke-Cherry)	Thicket Forming	Aug.-Sept.
Corylus cornuta (Beaked Hazelnut)	Thicket Forming	Aug.-Sept.
Cornus canadensis (Bunchberry)	Colonial	July-Sept.
Cornus stolonifera (Red Osier)	Thicket Forming	Aug.-Sept.
Fagus grandifolia (Beech)	Tree Species	

Methods

Past attempts to relate black bear productivity to mast yields have relied on ocular estimates of fruit and nut production (Rogers 1976, Elowe 1987). Two problems are associated with this approach: 1) annual changes in personnel increases the already inherent subjectivity of the method, 2) formulating a mathematical relationship between recruitment and mast production is impossible.

Separate methods are proposed for sampling mast production of tree and shrub species. Sampling may be conducted anywhere within a designated sampling unit (G.I.S. Mapsheet Division).

Tree species : Estimates of nut\berry production will be made only on dominant and co-dominant trees and in that portion of the crown exposed to direct sunlight. Counts will be made on the first 25 twigs encountered on each tree (Petrides et al 1953). Pole pruners or binoculars may be used to assist in the counting. Five trees of each species will be included in a sample.

Shrub species : Counts of total berries\nuts within five 1 sq. metre quadrats will be made for each species. Sampling must be conducted only where plants are contiguous over an area equal to or exceeding 1 sq. metre and where the density of fruit appears representative.

Interpretation of Mast Data

Eventually, estimates of mast production over a period of successive years will enable us to categorize food abundance on a relative scale (e.g. Abundant, Moderately abundant, Scarce). Forecasts of pregnancy rates and cub survival can then be adjusted annually in accordance with estimated mast yields.

APPENDIX F

SCENT STATION INDEX

Scent Station Index

Scent station procedures were first designed for indexing coyote abundance (Linhart and Knowlton, 1975). Since then, the technique has been used primarily for indexing populations of small carnivores (Johnson and Pelton, 1981; Roughton and Sweeny, 1979; Conner et al, 1983; Johnson et al, 1987). Lindzey et al (1977) proposed that the technique could be adapted to provide an index of black bear abundance.

Morrison et al (1981) listed the advantages of scent station procedures that make them an attractive means to index populations: 1) uniformity of station design, 2) repeatability, 3) reasonable man-hour expenditures, 4) applicable to extensive land areas, 5) yields data that can be analyzed statistically and 6) data are comparable from year to year.

The technique is not without limitations. Wind and rain can obliterate tracks and thereby disrupt schedules, although the repeatability of the technique offsets this somewhat. Also, uncommon species (such as black bear) usually require more than one night of observations (Roughton and Sweeny, 1982). Neither of these problems are insurmountable, making the scent station technique a practical means of determining trends in black bear populations. It must be reiterated that scent station index procedures provide only an index of relative population abundance and do not derive an estimate of actual abundance or population size. Without a measure of animal density, only population trends are reflected in scent station data.

Using the scent station technique for bears requires several modifications to procedures used for less widely ranging carnivores.

Scent Station Design

The scent station should be a cleared circle of 1 meter radius (Lindzey et al, 1977). The surface of the ground within this circle should be raked to remove debris and rocks to provide a good medium for track impressions. There is no

standardized attractant for scent stations for black bears; however, many researchers report highest visitation rates with odorous food baits (Pelton,1984). The attractant is secured to a stake or tree situated in the centre of the circle. This reduces the possibility of removal of the bait from the station by smaller predators and allows for greater distribution of the bait's scent.

Fine dust or dirt can be sifted through a screen over the scent station to provide a better medium for track impressions; however, the relatively heavy mass of a bear may make this action unnecessary.

Survey Line Design

Survey lines should consist of a minimum of 10 scent stations. For black bears, stations should be placed at 3-5 kilometre intervals along a continuous route in areas considered to be good black bear habitat.

Lines should be established only on unimproved (dirt) roads to reduce the influence of motor vehicle traffic on visitation rates. Distance between lines should be a minimum of 8 km. Scent stations should be located within 50 m of the road, thereby allowing time for the observer to tend a greater number of stations.

A scent station line should be checked each day for four consecutive days before being abandoned. This will allow for a greater number of lines to be established, thus a larger area is surveyed.

Scent stations must be located far enough apart that the chance of an individual bear visiting more than one station during the period of observation will be small. The value of 3-5 km as an interval between stations was selected after reviewing average daily movements of male and female black bears (Table 11). Similarly, the distance between survey lines should be great enough to keep an individual bear from visiting more than 1 line during the period of observation.

Table 11. Average daily movements for male and female black bears during summer.

State/Province	Males $\bar{X}$ (KM)	Females $\bar{X}$ (KM)	Authority
Idaho	1.7	1.4	Amstrup and Beecham, 1976
Pennsylvania	15.2	5.4	Lindzey *et al*, 1977
Pennsylvania	7.02	3.29	Alt *et al*, 1976

The number of scent station lines established should take into consideration the size (area) of the wildlife management zone Each scent station may have an influence area of a circle with radius = 2.5 km = 19.6 sq. km. Given that there should be 8 km between survey lines, each line represents an area of 400 sq. km. The number of possible lines per wildlife management zone is presented in Table 12.

Survey Timing

Scent station surveys should take place at the time of greatest bear activity (Roughton and Sweeny,1982). This corresponds to breeding season when males and females are most active and subadults are dispersing. Although breeding is taking place in late June, this month is unavailable for censusing because the spring hunting season is still in progress. Given this, July is the best time to census bears using the scent station technique. Breeding is taking place and the weather is relatively stable, making visitation rates high and track impressions distinct and lasting (Pelton,1984).

Table 12. Number of possible scent station survey lines for each wildlife management zone.

Zone No.	Area (Sq. Km.)	Number of Survey Lines
1	826	3
2	2722	7
3	2877	15
4	3647	10
5	3246	9
6	2603	7
7	6403	16
8	4155	11
9	1130	3
10	2826	7
11	2515	7
12	3427	9
13	2647	7
14	2610	7
15	2795	7
16	4266	11
17	3308	9
18	2666	7
19	2215	6
20	5341	14
21	2562	7
22	2945	8
23	2772	7
24	1979	5
25	2062	5
26		n/a
27		n/a